

Zoogeographic Significance of a Late Quaternary Occurrence of the Bivalve *Astarte* off the Central California Coast¹

BY

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(1 Plate; 1 Map)

INTRODUCTION

ABUNDANT FOSSIL SPECIMENS of a small, high-beaked *Astarte* dredged off the central California coast (lat. $36^{\circ}27'N$) constitute a unique southward range extension of this cool-water genus in the eastern North Pacific during what is believed to be the latest Pleistocene time. Today the genus *Astarte* ranges southward along the eastern North Pacific coast to the Strait of Juan de Fuca (lat. $48^{\circ}N$), where it is represented by several living species. Its southernmost previously known occurrence during the late Pleistocene was in the nearby Strait of Georgia area (lat. $49^{\circ}30'N$) of southernmost British Columbia (WAGNER, 1959). The new record of this cool-water genus off central California is inferred to represent a brief but significant southward extension of range during the Wisconsin Glaciation and this is taken as evidence of cooling of the shallow-water environment.

OCCURRENCE

Some 60 specimens of *Astarte loxia* Dall, 1903 were recovered from a dredge haul made by Greene on November 5, 1971 near the head of an unnamed tributary to Monterey Submarine Canyon about midway between the mouth of Carmel River and Point Sur and about 5 km offshore (Figure 1). The dredge started at lat. $36^{\circ}26'N$ and long. $122^{\circ}W$ and terminated at lat. $36^{\circ}27'30''N$ and long. 122°

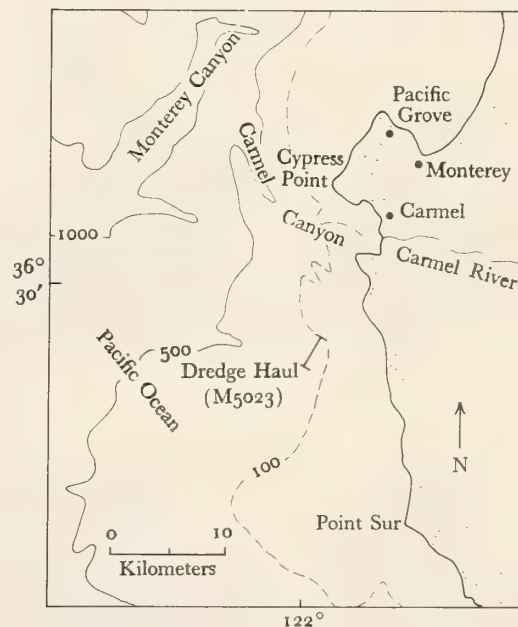


Figure 1

Index map showing location of dredge haul (USGS Cenozoic loc. M5023). Bathymetric contours in fathoms.

$01'W$. Over this course the dredge hit bottom at a depth of 300 m. Dredging continued upslope to a depth of 180 m. The dredge, an 18- by 36-inch (45 by 90 cm) pipe dredge,

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yielded well-sorted, medium- to coarse-grained unconsolidated sand containing pebbles of granite, chert, and shale and abundant shells. Living mollusks and other larger invertebrates were separated from the sample. The fossiliferous component has been assigned USGS Cenozoic locality no. M5023.

PALEONTOLOGY

The small specimens of *Astarte loxia* Dall (Figures 6 to 9) are exceptionally variable in shell outline. They are characterized by an accentuated, anteriorly pointed beak, and by a rounded ventral margin. Most are highly inequilateral in outline (Figures 6 to 9). The surface is nearly smooth, being marked only by very fine concentric growth lines. There is no tendency for these lines to be accentuated in the umbonal region as on certain weakly sculptured forms of the similar North Atlantic and North Pacific species *A. montagui* (OCKLEMAN, 1958: 84; MACGINITIE, 1959: 168).

DALL (1903: 943) described *Astarte loxia* as a "pale oblique variety" of *A. rollandi* Bernardi based upon material dredged from 20 fathoms (36m) off the Semidi Islands about 175 km southwest of Kodiak Island, Alaska. This previously unfigured taxon is here considered sufficiently distinct from the large, thick-shelled *A. rollandi* to be treated as a full species. Specimens in the type lot are characterized by a variable outline, a produced posterior extremity, an accentuated beak, a heavy hinge with a swollen area extending from beneath the cardinal area to the deeply sunken anterior muscle scar, and a smooth exterior marked only with fine, irregular lines of growth (Figures 2 to 5). *Astarte loxia* ranges from Akutan Pass in the Aleutian Islands (long. 166° W) northeastward

to Prince William Sound, Alaska (BURCH, 1944 (39): 6). Although characteristic of the North Pacific rim, the species has been dredged off the outer coast of northwestern Washington near Destruction Island (Figures 12, 13) and there is a doubtful occurrence from the nearby Straits of Juan de Fuca, Washington (USNM 222364). *Astarte loxia* is an inner sublittoral species in the northern part of its range, occurring in sand and gravel at depths of 12 to 34 fathoms (21.6 to 61.2m); off Washington, however, it ranges into the outer sublittoral zone having been dredged from between 50 and 100 fathoms (90 and 180m) near Destruction Island.

Astarte loxia is similar to *A. bennetti* Dall, 1903, a species that seems to have been incorrectly identified by many workers because the holotype (Figures 14 to 17) has not previously been illustrated and the original illustration used by DALL (1903: pl. 63, fig. 6) in describing this species was a specimen from the Bering Sea (USNM 109279) that differs significantly from Dall's holotype from the Arctic Ocean (USNM 83221). As might be expected, subsequent recognition of *A. bennetti* (MACNEIL, 1957: pl. 15, figs. 10, 11; pl. 16, fig. 10; HABE, 1964: pl. 55, fig. 7) seems to have been based upon the illustration of the specimen from the Bering Sea and not on the unfigured holotype.

The holotype of *Astarte bennetti* (USNM 83221) differs significantly in outline from Dall's Bering Sea specimen. It is a smooth, elongate individual with a straight growth line segment along the posterior ventral margin and an acutely rounded posterior extremity (Figures 14 to 17). In contrast, DALL's (1903: pl. 63, fig. 6) illustrated specimen from the Bering Sea has regularly rounded ventral and posterior margins but differs from the type, and from *A. loxia*, in having fine concentric ribbing on the posterior one-third of the valve. The ribbing is not clearly

Explanation of Figures 2 to 17

(all figures $\times 3$ unless otherwise noted)

Figure 2: *Astarte loxia* Dall, **paralectotype**, USNM 647234, sta. 1152 Semidi Islands, Alaska. Holocene. $\times 2\frac{1}{2}$

Figure 3: *Astarte loxia* Dall, **paralectotype**, USNM 647235, sta. 1152 Semidi Islands, Alaska. Holocene. $\times 2\frac{1}{2}$

Figures 4 and 5: *Astarte loxia* Dall, **lectotype**, USNM 169531, sta. 1152 Semidi Islands, Alaska. Holocene. $\times 2\frac{1}{2}$

Figures 6 and 7: *Astarte loxia* Dall, USNM 647236, USGS Cenozoic loc. M5023, dredged off central California near lat. 36°18'N and long. 122°W. Late Pleistocene.

Figure 8: *Astarte loxia* Dall, USNM 647237, USGS Cenozoic loc. M5023, dredged off central California near lat. 36°18'N and long. 122°W. Late Pleistocene.

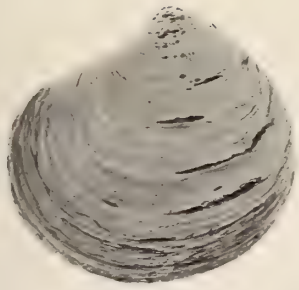
Figure 9: *Astarte loxia* Dall, USNM 647238, USGS Cenozoic loc. M5023, dredged off central California near lat. 36°18'N and long. 122°W. Late Pleistocene.

Figure 10: *Astarte* cf. *A. arctica* Gray, SUPTC 10071, Stanford Univ. loc. 41721, Work Canal, British Columbia. Holocene. $\times 2\frac{1}{2}$

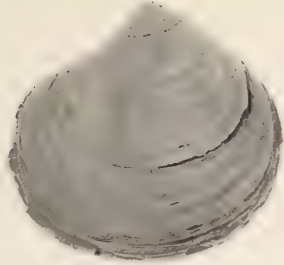
Figure 11: *Astarte* cf. *A. arctica* Gray, SUPTC 10072, Stanford Univ. loc. 41721, Work Canal, British Columbia. Holocene. $\times 2\frac{1}{2}$

Figures 12 and 13: *Astarte loxia* Dall, CAS 53662, California Acad. Sci. loc. 39500, near Destruction Island, Washington. Holocene.

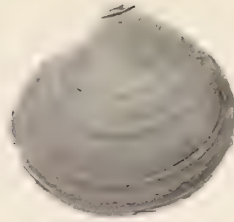
Figures 14 to 17: *Astarte bennetti* Dall, holotype, USNM 83221, Bennett Island, Arctic Ocean. Holocene.



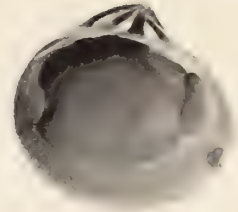
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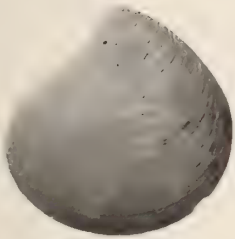
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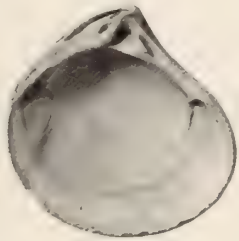
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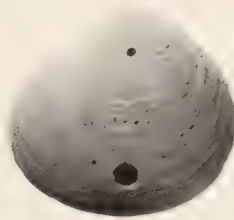
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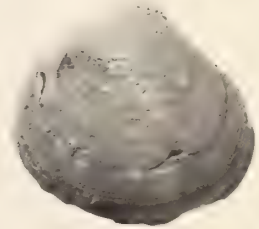
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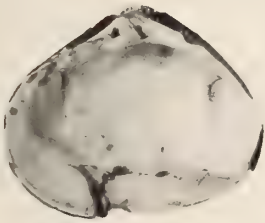
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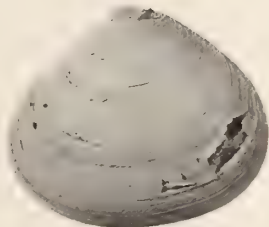
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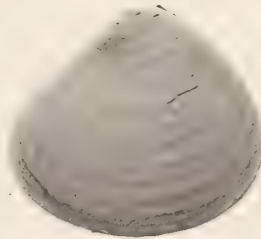
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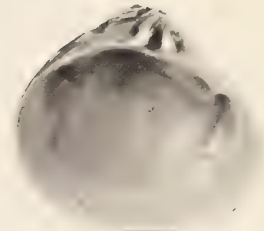
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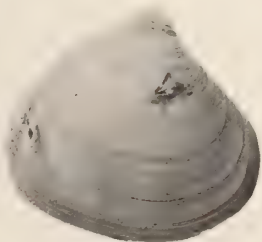
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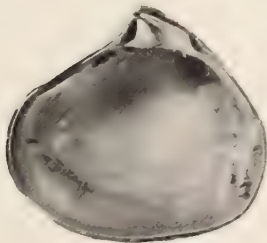
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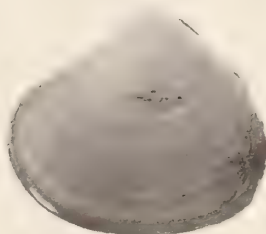
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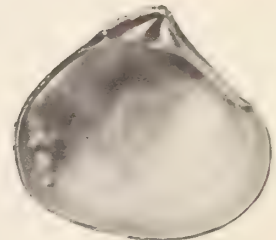
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